A. Cover Sheet *(Attach to front of proposal.)*

1. Specify: ☐ agricultural project or ☒ urban project ☒ individual application or ☐ joint application

2. Proposal title—concise but descriptive: Quantifying the Potential for Demand Side Management in California's CII Sector

3. Principal applicant—organization or affiliation: Pacific Institute for Studies in Development, Environment, and Security

4. Contact—name, title: Dr. Katherine Kao Cushing, Research Associate, Dr. Peter Gleick, Institute Director

5. Mailing address: 654 13th Street Oakland, CA 94612

6. Telephone: (510) 251-1600

7. Fax: (510) 251-2203

8. E-mail: k_cushing@pacinst.org

9. Funds requested—dollar amount: $ 72,500

10. Applicant cost share funds pledged—dollar amount: $ 72,500

11. Duration—(month/year to month/year): June 15, 2001 to June 15, 2002

12. State Assembly and Senate districts and Congressional district(s) where the project is to be conducted: The project will cover all State Assembly and Senate districts in the State of California.

13. Location and geographic boundaries of the project: This work will include commercial, industrial, and institutional water users statewide. Particular attention will be paid to major urban areas in the Bay-Delta region.

14. Name and signature of official representing applicant. By signing below, the applicant declares the following:
- — the truthfulness of all representations in the proposal;
- — the individual signing the form is authorized to submit the application on behalf of the applicant;
- — the applicant will comply with contract terms and conditions identified in Section 11 of this PSP.

Katherine Kao Cushing *(printed name of applicant)*

2/14/01 *(date)*

Katherine Kao Cushing *(signature of applicant)*

ITEM B.—SCOPE OF WORK

Abstract

Collectively, California's commercial, industrial, and institutional (CII) water users account for about one-third of all urban water use. Recent surveys and actual experiences at specific sites indicate that the potential for water conservation in this sector is high. However, there has not been a recent study that attempts to aggregate these kinds of potential water savings at the state level. This project will develop, for the first time in California, appropriate methods for quantifying a range of water demand management options in the CII sector to produce real, independent estimates of the potential water savings from these options. Where applicable, particular attention will be paid to CALFED's hydrologic regions of interest. The proposed project will focus on finding answers to three overarching research questions. First, "What is current CII water demand at the state-wide level?" Second, "What kinds of demand management alternatives are currently being practiced in the state's CII sector?" And third, "Considering conservation practices, how much water will the state's CII sector need in the future?"

To estimate CII demand, we will utilize water use coefficient data and employment statistics to calculate a volumetric estimate of statewide CII water use. The identification of water conservation technologies will be accomplished through completing an ongoing review of demand management assessments that have already been conducted. We will synthesize these studies to produce a list of conservation technologies that hold the most promise for particular CII sub-sectors or individual Standard Industrial Classification (SIC) codes. Finally, we will quantify demand side management potential by presenting several conservation "scenarios." These will be developed by summing the additive effects of conservation technologies applied under a number of different technology penetration and use rates and cost-benefit conditions. The resulting information will be peer reviewed and published as a Pacific Institute report for direct use in ongoing California water policy discussions.

Introduction

California's water debates have always been rancorous and complex, and they have always been characterized by inadequate or incomplete information. As we enter the 21st century, great progress has been made in building bridges among the competing water interests and in expanding directions for discussing and resolving disputes. One of the major new factors in California's long water debate is a discussion about the potential for demand management of California's water resources and improving the productivity of water use statewide. Unfortunately, serious information gaps have inhibited that discussion. This information is vital to decisions concerning the Bay-Delta and about setting a whole range of ecological, agricultural, and urban policy priorities. Without this kind of information, questions about the State's future industrial production, immigration reform, and urban growth will be much harder to answer. This project will develop, for the first time in California, appropriate methods for quantifying a range of water demand-

management options in the commercial, industrial, and institutional (CII) water use sector to produce real, independent estimates of the potential water savings from these options. The resulting information will be peer reviewed and published as a Pacific Institute report for direct use in ongoing California water policy discussions.

The CII sector comprises a substantial percentage of urban water use. According to statistics from California's Department of Water Resources (DWR), the CII sector accounts for approximately 32% of all urban water use. Of that 32%, 17% is categorized as commercial, 8% as industrial, and 7% as institutional (DWR 1990). And while the potential to conserve water for residential uses of water have been widely studied, the potential to increase water use efficiency in the CII sector is less well understood, due in part to the large variety of water uses and technologies.

Recent surveys and actual experiences at specific sites indicate that the potential for water conservation (and associated cost savings) in this sector is high. For example, a survey conducted by the Metropolitan Water District (MWD) of Southern California concluded that conservation of its CII customers could yield water savings of 23 to 29% (Sweeten and Chaput 1997). And at Oberti Olives, one of the state's largest food processesors, adoption of membrane filtration technology, resulted in a 90% reduction of its groundwater consumption (Pacific Institute 1995).). A wide variety of other case studies are also available. To date, however, there has not been a study that attempts to aggregate these kinds of potential water savings at the State level.

Research Questions

To address this data gap, our project focuses on finding answers to three overarching research questions, with particular attention being paid to hydrologic regions of interest to the CALFED process. First, "What is current CII water demand at the state-wide level?" The latest DWR data on statewide CII water use was published in 1990 and is inadequate for describing current conditions. Our project would bring this estimate up to date using information from more current sources, such as the raw data from DWR's 1994 Survey of Manufacturers. A reasonable estimate of current use is the first step in estimating future potential for conservation.

Our second research question is, "What kind of demand management alternatives (i.e., water conservation techniques) are currently being practiced in the state's CII sector?" Urban water conservation programs in California are currently driven by a set of "best management practices" (BMPs) that are entirely voluntary and limited in scope. This project will go beyond the BMPs and include a technology-based consideration of specific conservation technologies and practices. In addition, we will examine the economic costs and benefits of adopting these technologies.

Finally, our third research question is, "Considering conservation practices, how much water will the state's CII sector need in the future?" Our objective here is to provide several "scenarios" for water conservation in CA's CII sector: (1) "business as usual," (2) adoption of all cost-effective measures, and (3) maximum conservation technology

penetration. We will try to coordinate our projections with the efforts underway by DWR for the Bulletin 160 process.

The implementation of the proposed project is important for several reasons. First, current data on sector-wide water use are outdated. Baseline conditions need to be more representative of current water use patterns before any reasonable use projections can be made. Second, the analysis that will result from the project will show how a more comprehensive consideration of efficiency alternatives may decrease future water demand. Additionally, this project will provide water utility managers and CII water users with comprehensive information on a wide variety of conservation technologies and their potential water- and cost-savings. Finally, conservation measures adopted as a result of this study by individual CII water users will result in reduced environmental impacts on their surrounding communities.

Research Methodology and Data Sources

There are three phases to this project:

Phase I: Estimating Current CII Demand
Phase II: Identification of Demand Management Alternatives
Phase III. Quantification of Water Savings from Each Alternative

Phase I: Estimating Current CII Demand

In this phase of the project we will use water use coefficient data and employment statistics to calculate a volumetric estimate of statewide CII water use. Reliable, detailed, and comparable data for current water use in this sector are difficult to obtain (Pacific Institute 1995; Sweeten 2000; Pike 2000), since water service agencies generally do not use a common categorization scheme such as the Standard Industrial Classification (SIC) codes or NAICS codes. Nonetheless, the SIC code classification system does provide a systematic way of collecting and evaluating data on water use. As part of this phase, we will derive water use coefficients (e.g., gallons of water used per employee per day) for SIC codes that comprise the majority of CII water use statewide.

In 1994, DWR administered a statewide survey to over 4,000 industrial water users. To date, the raw data has not been comprehensively analyzed to generate an "official" estimate of statewide industrial water use, largely due to resource constraints. DWR staff have stated in the past that the Institute's independent analysis of this data set would be welcome (Pike 2000). We will analyze this information, in consultation with staff from DWR, to calculate individual water use coefficients for SIC codes 20 to 39. Coefficients will be derived by dividing the total annual water use for firms in a particular SIC code by the number of respondents. This amount will then further be divided by the number of reported employees for respondents in that particular SIC code, using the general method shown below.

For individual SIC codes:
water use coefficient (gal/emp/day) = total water use (gal/day) / # of employees

Water use coefficients that we calculate using this method will be compared to use coefficients generated by other studies, such as the 1991 Spectrum Economics study, and use coefficients calculated by individual water service agencies. If needed, adjustments will be made. Following these comparisons, we will put forward our own updated estimates of reasonable water use coefficients for industrial water users statewide by SIC code.

Unlike industrial water use, there has not been a recent statewide survey of commercial and institutional water users. Our estimate of these coefficients, therefore, will rely on best available data from previous studies of commercial and institutional water use, such as the 1996 study of water use in San Diego County conducted by the consulting firm PMCL. DWR uses survey data from over 300 large water service purveyors to estimate commercial and institutional water usage. This project will utilize water use coefficient and employment data to provide another way of looking at water use in this sub-sector.

Once reasonable water use coefficients are identified for key SIC codes or SIC code groupings, we will multiply them by the number of people employed in a particular SIC code(s) to arrive at a volumetric estimate (in acre-feet) of water use for particular organization types (e.g., food processing, institutional water users).

The California Employment Development Department (EDD) regularly collects comprehensive employment data on all industrial, commercial, and institutional sub-sectors by SIC code. Sample calculations for two SIC groupings—Construction and Transportation and Public Utilities—are shown below.

Sample Calculations for Determining Water Use by SIC Code

Industry Group	SIC Code	Sample	Gal/emp /day	Work days/yr	No. full-time Employees 1994	Water Use 1994 (acre-ft)	Emp 1998	Water Use 1998* (acre-ft)
Construction	15-17	22	22	250	464,300	7,836	611,200	10,315
Transportation and Public Utilities	40-49	387	75	350	619,000	49,858	695,400	56,012

*These calculations assume that 1994 per employee water use efficiencies have not improved between 1994 to 1998. In the final version of these calculations, attempts will be made to adjust for improvements in water use efficiency by SIC code.

Sources: CA EDD 2000; PMCL, 1996.

Phase II: Identification and Assessment of Demand Management Alternatives

The second step of the project involves completing an ongoing review of demand management assessments that have already been conducted. This work will build on

previous work conducted by the Pacific Institute, as well as other related studies that have been conducted by others. Two publications of the Institute will be of particular use: "California Water 2020: A Sustainable Vision," and "Sustainable Use of Water: California Success Stories." This work will provide detailed background data and examples for use in the proposed project.

Our method of assessing the costs of benefits of conservation technologies will build off the work we have already done in the State's residential sector. This method estimates the capital expenditures and operating cost savings associated with each conservation measure that would occur anywhere in the State. For example, the incremental capital cost of purchasing and installing a water-efficient clothes washer will occur anywhere this conservation measure is implemented, although of course that cost will vary somewhat within the State. Our extended cost-benefit analysis will include consideration of direct secondary benefits, such as energy savings from reduced pumping or heating demands.

Expenditures and cost savings that may be significant in some parts of the State but zero in others (e.g., wastewater treatment costs avoided due to conservation), will be addressed via sensitivity analysis on the base economic case. The "output" of this economic method is a set of minimum costs-per-acre-foot-equivalent for each water conservation measure. Whenever such a cost is less than the current price of water, we will conclude that water conservation from that measure is cost-effective. We will then obtain a minimum, State level aggregate estimate of cost-effective water conservation by comparing the cost of conservation measures with the price of water in as many regions of the State as is feasible, given the water price information that is available.

Other research done in this field outside of the Institute will also play a role in this phase. Among the more important pieces are a 1991 Spectrum Economics Study, a 1997 EPA/CA DWR study (Pike 1997), and studies done by the AWWA (AWWARF 2000), the work of water resources consulting firms, such as PMCL (1996), and detailed case studies conducted by water utilities.

Phase III. Quantification of Water Savings from Each Alternative

This project will quantify the potential from the current BMPs under full implementation and will extend the current (outdated) BMP estimates. New work will be done to identify water conservation potential in the CII sector, and the potential for greater application of reclaimed and recycled water programs. This will involve compiling disaggragated information from water agency audits that have been conducted in the past several years. These estimates will then be compared with recent estimates from implementation of current urban BMPs.

Again, SIC codes, either individual or grouped, will be used as the basis for calculating water savings. For each SIC code or group of similar SIC codes, we will use the following general procedure to quantify potential water savings (final analytical methods will be developed during the project). First, we will identify major conservation technology options. Then for each major conservation technology we will:

1. Collect data on penetration and use rates
2. Estimate future penetration and use rates
3. Determine theoretical potential water savings, assuming maximum technology use
4. Develop estimates of water savings with implementation of cost-effective technologies
5. Conduct sensitivity analysis, adjusting parameters as needed

The end result of this phase of the project will be a set of conservation scenarios that illustrate how much water the state's CII sector will need in the future under differing conservation situations: (1) "business as usual," (2) adoption of all cost-effective measures, and (3) maximum conservation technology penetration.

Technical options will be evaluated using the following approach and assumptions:

1. No new technology will be assumed – only existing and commercially available options will be evaluated.
2. Water use data from new technologies will be determined from existing testing data.
3. Existing penetration and use rates (e.g. technology use per employee, uses per unit time) will be determined from existing public survey and research data.
4. Where applicable to a particular water-saving appliance, current water use volumes will be computed using variants of:

$$\text{(Population cohorts)} \times \frac{\text{technology penetration rates}}{\text{(population)}} \times \frac{\text{water use}}{\text{(technology use)}} \times \frac{\text{technology use rates}}{\text{(time)}}$$

However, depending on the nature of certain water users (e.g., food processors), different calculations may be used to estimate water savings for industry-specific conservation measures.

5. Two sets of assumptions will be made for penetration of new technologies: (a) actual historical rates of technological turnover; and (b) full penetration. These two assumptions will give a time dependence of conservation efficiency improvements and a maximum ultimate potential for any given alternative. Both numbers will be reported.

Work for the proposed project will be conducted by Pacific Institute staff at the Pacific Institute's offices in Oakland, California. The office is supplied with sufficient computer, internet, telecommunications, and reproduction technology to support the study's research and outreach activities.

REFERENCES CITED AND PERSONAL COMMUNICATIONS

American Water Works Association Research Foundation (AWWARF). 2000. "Commercial and Institutional End Uses of Water." Research Foundation Report. AWWARF.

California Department of Water Resources (CA DWR) 1994. *Urban Water Use in California*. Bulletin 166-4.

California Employment Development Department (CA EDD). 2000. "Labor Force Statistics: Annual Average Historical Employment." Available: [Online]: http://www.calmis/ca/gov/file/indhist/ca$haw.xls.

Pacific Institute. 1999. *Sustainable Use of Water: California Success Stories*. Oakland, CA: Pacific Institute.

Pacific Institute. 1995. *California Water 2020* : A Sustainable Vision. Oakland, CA: Pacific Institute.

Pike, C. 1997. "Study of Potential Water Efficiency Improvements in Commercial Businesses." Final report, U.S. Environmental Protection Agency/California Department of Water Resources. April.

Pike, C. California Department of Water Resources. Personal communication(s) with Katherine Kao Cushing. 4 April 2000.

Planning and Management Consultants, Ltd. (PMCL). 1996. "Development of Municipal and Industrial Water Use Forecasts for the San Diego County Water Authority." Final Report. April.

Sweeten, J. Metropolitan Water District of Southern California. Personal communication with Katherine Kao Cushing. 18 April 2000.

Sweeten J., and B. Chaput. 1997. "Identifying the conservation opportunities in the commercial, industrial, and institutional sectors." Paper presented at the June 1997 annual American Water Works Association meeting.

Spectrum Economics, Inc. 1991. "Cost of Industrial Water Shortages." Report prepared for the California Urban Water Agencies. November.

Project Schedule, Monitoring, & Assessment

Please see attached bar chart schedule for details on major tasks, deliverables, and due dates. Projected quarterly expenditures for the project are listed below.

Quarter	Projected Expenditures	Amount Requested (50%)
Q1	$32,000	$16,000
Q2	$27,000	$13,500
Q3	$26,000	$13,000
Q4	$60,000	$30,000
TOTAL	**$145,000**	**$72,500**

Upon completion of each of the project's three phases, we will discuss preliminary conclusions with a select group of key stakeholders to ensure that our findings and methods are reasonable. A draft of the final project report will also be peer reviewed by a small group of water professionals from DWR, CALFED, the CUWCC, and other academic and conservation-related organizations. All substantive reviewer comments will be considered when making revisions to the final version of the report.

Data for the project will be available through two principle means. First, the hardcopy version of final report will contain the study's key findings as well as analysis of and reference to key data sets and sources. Select data sets will also be publicly available on our worldwide web site: www.pacinst.org. However, due to confidentiality concerns, not all the raw data used for the project will be posted on the site.

ITEM C.—OUTREACH, COMMUNITY INVOLVEMENT, AND INFORMATION TRANSFER

Outreach for the proposed project will be implemented by project staff in conjunction with the Institute's Director of Communications. Activities comprising the majority of our outreach efforts will include: (1) distributing and promoting the final report "Quantifying the Potential for Demand Side Management in California's Commercial, Industrial, and Institutional Water Use Sector," (2) co-hosting a workshop on the study's main findings and methods, (3) informing key water resource organizations, and (4) publicizing study findings through professional conferences and use of electronic and print media.

The project's final report will be distributed to several hundred water resource planners (in California as well as other states), conservation professionals, industrial and trade associations, and environmental managers in individual organizations. Coincident with the release of the report will be a press briefing, and the release will also be promoted in several prominent water resources management publications.

Upon completion of the main report, we plan to hold a joint workshop with DWR. The workshop will have two objectives. For state water planners, the workshop would serve as a forum for discussing the methodology and data sources used in the project and

determining the potential applications of our work in state water resources planning. For CII water users and water utilities we will also devote a large portion of the workshop to discussing the major conservation technology options identified in the report, as well as methods for quantifying their water savings potential and their economic costs and benefits. We have had previous discussions with DWR staff (Pike 2000) on this subject and they have been receptive to co-hosting an event like this with us. We estimate that 50 to 100 professionals will participate in this capacity-building workshop.

Through our presence on key water resources committees and councils, we will inform key stakeholders on the results of our study. Dr. Peter Gleick sits on the advisory committee for DWR's Bulletin 160 and he will be an advocate for using the report's estimates of potential water savings in DWR's work. The Institute is also a member of the California Urban Water Conservation Council. By participating in the Council, we will relate and promote the project's findings to the organization's many members. We also plan to work directly with CALFED staff and assist them in understanding how the results of the project can be applied in CALFED's hydrologic regions of interest.

Collaboration with water service providers is another way in which we will collect information for and disseminate information about the project. We have had preliminary communications with a variety of State water service providers, including MWD of Southern California and EBMUD. These organizations have expressed interest in the project and are supportive of its main goals. Some have even volunteered to share customer data with us to aid us in our effort of developing realistic water use coefficients for the sector.

Finally, major findings and recommendations of the report will also be publicized in several other venues. An electronic version of the report, along with key data sets, will be publicly accessible via our worldwide web site. This site is very popular among water resource professionals, receiving more than 150,000 "hits" monthly. In addition, the report will be promoted through electronic listserves. Currently, the Pacific Institute corresponds with approximately 15 such water-related lists. Project staff will also make report-related presentations at major conferences and professional association events.

Please note that since the project is primarily research based (as opposed to an actual pilot project), the letter of notification requirement to a local land use entity is not applicable to this proposal.

ITEM D.—QUALIFICATIONS OF APPLICANTS, COOPERATORS, AND ESTABLISHMENT OF PARTNERSHIPS

The Pacific Institute for Studies in Development, Environment, and Security is an independent, non-profit center created in 1987 to conduct research and policy analysis in the areas of sustainable development. We are a leading independent policy institute analyzing California water policy and planning issues. Staff for the proposed project have strong academic and practical backgrounds. They bring with them an impressive history

of experience working on water resource issues in California and the West (please see attached resumes).

For the past several years the Institute has been working with a number of water utilities agencies and professionals in its examination of residential water uses. Our cooperation with some groups has progressed to the point where the Institute is seen as a source of expertise in residential water conservation to organizations such as EBMUD. The proposed project would build on the good relationships we have developed in this area and extend them to the CII sector. We plan to work collaboratively on an informal basis with organizations such as DWR and water utilities, sharing data sets and analytical methods. Because we have been and will continue working with key implementing organizations, the project will not end when the report is disseminated. Rather, the project will complement existing efforts to improve water planning techniques and promote adoption of water conservation technologies.

ITEM E.—COSTS AND BENEFITS

Budget Summary and Breakdown

The budget for the proposed project is $145,000. The cost share portion we are requesting from the CALFED Water Use Efficiency Program is 50%, or $72,500. The other 50% of project funds will be covered by funds the Pacific Institute has received from the Luce and Hewlett foundations. The specific budget line items and a breakdown of human resource needs are presented in the tables below.

Proposed Project Budget

Item No.	Description	Cost	Cost Share (50%)	Amt Request (50%)
A	Salaries and Wages	$82,000	$41,000	$41,000
B	Fringe Benefits	$19,000	$9,500	$9,500
C	Supplies*	$0		
D	Equipment*	$0		
E	Services or Consultants	$10,000	$5,000	$5,000
F	Travel	$4,000	$2,000	$2,000
G	Other direct costs	$4,000	$2,000	$2,000
H	Indirect costs (22%)	$26,000	$13,000	$13,000
I	**TOTAL**	**$145,000**	**$72,500**	**$72,500**

*Supplies and equipment factored into "Indirect costs," which also includes other overhead expenses such as utilities and office rent.

Breakdown of Project Human Resource Needs

Position	% time over 12-month period
Research Associate	50%
Research Associate	20%
Institute Director	10%
Economist	20%
Graduate student intern	50%
Communications Director	5%
Administrative Assistant	18%

Budget Justification

Since the proposed project is primarily a research project the majority of the project budget will go towards the direct and indirect costs associated with supporting Institute staff. The $4,000 travel budget will be used for several data gathering and outreach activities including data collection trips to utilities located outside the San Francisco Bay area. The $4,000 expense listed under "other direct costs" will go towards organizing and co-hosting a workshop with DWR. The $10,000 expense listed under "services or consultants" will cover the cost of professionally publishing the study's final report.

Benefits Summary and Assessment of Costs and Benefits

While the projected benefits of the proposed project will be significant, they cannot be easily quantified using conventional cost-benefit analysis. The purpose of our project is not to deliver direct quantitative benefits per se, but to show how such benefits can be realized and measured. This project focuses on data collection and quantification of potential water and cost savings that are difficult to determine a priori. Quantitative estimates of water and cost savings will be one of the main components of our final report, however. Previous research already conducted by the Institute on the State's residential sector has shown that the potential water, energy, and cost savings of implementing conservation techniques are significant. For example, we estimate that about 750 TAF of indoor residential water has already been saved through a combination of legislative requirements, conservation programs and efficiency improvements.

Beneficiaries

The primary beneficiaries of the proposed project are state and CALFED water planners, utilities, and CII water users. Water planners will benefit from the project by gaining a better understanding of how a more comprehensive consideration of conservation alternatives may decrease future water demand. It will show how data at the organizational and regional level can be scaled up to make reasonable estimates of CII water use statewide, taking into account a wide range of conservation opportunities. CALFED staff will benefit from the project because the project's findings will illustrate how near future CII conservation efforts in the Program's hydrologic regions of interest may impact the availability of Bay-Delta water for alternative uses. Additionally, the project will provide utility managers and CII water users with comprehensive information on a wide variety of conservation technologies and their potential water-, energy-, and cost-savings. Conservation measures adopted as a result of this study by individual CII water users will also lead to reduced environmental impacts on surrounding communities.